INVESTOR IN PEOPLE
The Patent Office
Concept House
Cardiff Road
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NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section74(1) and (4) of the Deregulation and Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the international application filed on 08 January 2001 under the Patent Cooperation Treaty at the UK Receiving Office. The application was allocated the number PCT/GB01/00047

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or the inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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Signed T A Roberts.

Dated 21 November 2001

PCT

8.1.2000

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

00047

International Application No.

8.1.2001

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* JL2836

Box No. I TITLE OF INVENTION

EMERGENCY LIGHTING

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE: OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

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Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*
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☒ applicant and inventor
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State *(that is, country)* of nationality: GB

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This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
☐ applicant only
☐ applicant and inventor
☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

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This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

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This person is:
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☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

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This person is:
☐ applicant only
☐ applicant and inventor
☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

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This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

☑ AP **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

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☑ OA **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* . . . . . .

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Check-box reserved for designating States which have become party to the PCT after issuance of this sheet:

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Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

See Notes to the request form

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) 08/01/00 (8 January 2000)	0000283.2	GB		
item (2) 25.07.00 (25 July 2000)	0018063.8	GB		
item (3) 25.08.00 (25 August 2000)	0020956.9	GB		

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): _____

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)*:

ISA /

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority)*:

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets**:

request	: 04
description (excluding sequence listing part)	: 42
claims	: 09
abstract	: 01
drawings	: 09
sequence listing part of description	:
Total number of sheets	: 85

This international application is **accompanied** by the item(s) marked below:

1. ☐ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract: 1 and 4

Language of filing of the international application: English

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Barker Brettell - 08.01.01

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1. Date of actual receipt of the purported international application:
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA /
6. ☐ Transmittal of search copy delayed until search fee is paid.

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EMERGENCY LIGHTING

This invention concerns improvements in or relating to emergency lighting and in particular, but not exclusively, to emergency lighting to indicate an escape route leading to an exit to assist evacuation of aircraft in an emergency, for example in the event of an accident.

The electrical lighting system provided in aircraft for normal use may be inoperable following an accident if the electrical connections to the power source are damaged. For example, the electrical connections may be broken by impact damage to the structure of the aircraft, and/or by fire and/or by water if the aircraft has to make an emergency landing on land or in the sea.

For this reason, it is a mandatory requirement to fit aircraft with an emergency lighting system operable independently of the normal lighting system to provide back-up in the event of failure of the latter and to assist evacuation of the aircraft by identifying an escape route for passengers to follow to the nearest exit.

It is known to employ in aircraft electrically powered emergency lighting systems at or near floor level and/or ceiling level. The emergency lighting is typically provided to identify an escape route along the aisle between the seats. Floor level emergency lighting is of benefit in a fire where smoke may block light from the normal overhead lighting (if still functional) and/or any ceiling level emergency lighting. Ceiling level emergency lighting is of benefit if the aircraft lands at sea where water may block light from any floor level emergency lighting.

These known electrically powered emergency lighting systems require a power source and wiring connections separate from the power source and wiring connections of the overhead electrical lighting system for normal use. This adds considerably to the installation costs.

Furthermore, being electrically powered, these known emergency lighting systems have been susceptible to failure at the time they are required as a result of damage to the power source (e.g. storage batteries) and/or the electrical connections in exactly the same way that the overhead electrical lighting systems for normal use may be rendered inoperable.

Another disadvantage of electrically powered emergency lighting systems is the additional servicing and maintenance work which has to be carried out to keep the system in good condition. Thus, the power source, electrical connections and light source such as bulbs have to be checked regularly and any damaged or broken parts replaced.

A further disadvantage of electrically powered emergency lighting systems is that pre-flight checks have to be carried out to ensure they are operational. An aircraft is prevented from taking off if the emergency lighting system fails during a pre-flight check and the aircraft is grounded until the emergency lighting system is repaired. Substantial costs can be incurred if an allotted take-off slot has to be vacated not to mention the inconvenience to passengers caused by a delay while the emergency lighting system is repaired.

We have previously proposed an emergency lighting system which is mounted on the floor of the aircraft and employs photoluminescent material arranged in a track extending along one or both sides of the aisle. The photoluminescent material is operable to emit light automatically to identify an escape route at low levels of illumination, for example if the normal overhead lighting is inoperable following a crash.

More particularly, the photoluminescent material is activated by exposure to a light source such as ambient light or the normal overhead lighting and releases light by means of the stored energy from such activation. In this way, the photoluminescent material is self-illuminating to identify an escape route for guiding passengers to an emergency exit at the time it is needed without any connections to a separate power source such as storage batteries required by conventional electrically powered emergency lighting systems.

Furthermore, the emission of light by the photoluminescent material is unaffected by damage to the track(s) and the emergency lighting system continues to operate even if the aircraft breaks up into several parts. As a result, the track(s) identify an escape route which passengers can follow to an exit or to an opening in the body of the aircraft to escape in an emergency.

This system has been widely adopted with success by many aircraft operators but is generally employed in combination with an electrical lighting system for emergency use on the ceiling. In addition, the tracks incorporating the photoluminescent material currently only serve to guide passengers towards the exits where electrically powered lighting systems are provided for emergency

use to illuminate the area between the tracks and the exits, and the controls and instructions for opening the exits. Such electrically powered lighting systems may take the form of overhead floodlighting and/or illuminated exit signs positioned above or at the side of the exit.

Accordingly, while the use of floor mounted tracks with photoluminescent material eliminates the need for a separate power source and electrical wiring connections, these are still needed for the other electrically powered lighting systems employed for emergency use and the problems and disadvantages of such electrical systems remain. Furthermore, although the floor mounted tracks with photoluminescent material are beneficial in identifying an escape route if the cabin fills with smoke, they may not be effective in other situations such as when the cabin fills with water.

The present invention has been made from a consideration of the problems and disadvantages of existing emergency lighting systems used in aircraft but which could also be used in other situations where rapid evacuation is critical to safety of passengers such as in a ship, train or coach following an accident.

Thus, it is a primary object of the present invention to provide further improvements in or relating to existing emergency lighting systems.

It is a preferred object of the invention to provide an integrated emergency lighting system which is operable totally independently of any power source to provide an illuminated escape route for passengers to follow to an exit, and to assist evacuation by

identifying the exit before and after it has been opened as well as facilitating operation of the controls to open the exit.

It is another preferred object of the invention to provide an integrated emergency lighting system which is operable totally independently of any power source to provide an illuminated escape route for passengers to follow to an exit at both low and high levels, for example at or near the floor and ceiling of an aircraft cabin.

It is yet another desired object of the invention to provide an emergency lighting system employing photoluminescent material arranged in a track which is simple to manufacture and install, and is easy to maintain.

In particular, it is a preferred object to provide a track in which the photoluminescent material is encapsulated in a unitary housing that provides total protection for the photoluminescent material and is easy to clean.

It is a further preferred object to provide a track in which the track is reversible and the photoluminescent material emits light to identify an escape route in both orientations of the track.

These and other object and advantages of the invention in its various aspects are described in more detail hereinafter.

According to one aspect of the present invention there is provided an emergency lighting system in or for an aircraft comprising photoluminescent guide means operable to identify an escape route leading to an exit, photoluminescent indicator means operable to

identify the exit in both open and closed conditions of the exit, and photoluminescent sign means operable to identify instructions and controls for opening the exit.

According to another aspect of the present invention there is provided a method of providing an escape route in an aircraft comprising providing photoluminescent means for guiding a user to an exit, for identifying the exit both when closed and when open, and for instructing a user to open the exit.

By the combination of the photoluminescent means to perform different functions according to the invention, the evacuation of passengers in an emergency is totally independent of any electrical lighting system which may fail as a result of damage in an accident or be of reduced efficiency in the presence of smoke or water blocking the emitted light.

By eliminating any electrical lighting with separate power source from the emergency lighting system, maintenance is reduced and pre-flight checks can be avoided. As a result, the cost and inconvenience of lost take-off slots due to failure of the emergency lighting system is no longer a problem as there are no electrical parts which require regular maintenance and checking.

Advantageously, the indicator means for identifying an exit such as a door is provided on one or both sides of the structure surrounding the exit, for example a doorway, and includes photoluminescent material such as zinc sulphide or strontium aluminate operable to provide illumination in conditions of darkness or low illumination.

This enables the user to locate the position of the exit both when it is closed and when it is open.

Preferably, the indicator means extends to a height of at least four feet on either side of the exit and more preferably, extends around the exit. In this way, the light emitted by the photoluminescent material frames the exit and provides a target for the user to aim for.

The photoluminescent material may be provided by an insert housed in an outer casing of a light transmissive plastics material such as polycarbonate for mounting on the structure surrounding the exit. Alternatively, the photoluminescent material may be applied to the structure in the form of a self-adhesive tape or paint and optionally overlaid with a protective cover of light transmissive material.

In addition to the use of photoluminescent material around all or part of the exit, the indicator means may further comprise the provision of photoluminescent symbols or words identifying the exit. For example, panels with the word exit and/or a symbol of a door may be provided on the door or surrounding structure. The word or symbol may be provided in photoluminescent material on a contrasting background or vice versa so as to stand out and be clearly visible. Again, the provision of panels on the surrounding structure serves to identify the location of the exit both when closed and open.

Preferably, the photoluminescent sign means for identifying the instructions and controls for opening the exit include a symbol such as an arrow behind a door handle to indicate the direction in which

the handle must be turned to open the door. The arrow may be photoluminescent on a contrasting background which may also be photoluminescent to identify the arrow. The handle may also be photoluminescent. The operating instructions may also be photoluminescent, for example instructions may be printed with photoluminescent ink on a contrasting background which may also be photoluminescent. The photoluminescence may be provided by any suitable material such as zinc sulphide or strontium aluminate.

Advantageously, the photoluminescent guide means is in the form of at least one track incorporating photoluminescent material such as zinc sulphide or strontium aluminate which is operable to illuminate the escape route in conditions of darkness or low illumination.

Preferably, the track includes symbols, words or other suitable markings separately or in any combination to indicate the direction to the nearest exit. For example, the track may include symbols like arrows and/or words such as exit to assist escape in an emergency.

The track may be provided in a continuous section. For example, the track may be formed in long lengths for cutting sections to the required length. The track may be sufficiently flexible to allow storage on a supply reel.

More preferably, however, the track is provided by a plurality of separate sections laid end to end. Thus, the track may be formed in one or more short sections of pre-determined length, for example 1 or 2 metres, which can be fitted in any combination and, where required, cut to shorter lengths to produce the required length of track.

The use of short sections in place of one continuous section facilitates handling and installation of the track and has other advantages in service. Thus, local damage to the track can be repaired by replacing the damaged section of track rather than replacing the whole track. Furthermore, in an accident resulting in the body of the aircraft separating into two or more parts, the sections of track remain with the associated part of the body to provide an indication of the escape route in each part.

The photoluminescent material may be continuous along the track or it may be provided at spaced intervals. A combination of continuous and broken regions of photoluminescent material may be employed to indicate the position of an exit. For example, the photoluminescent material may be continuous along the aisle and broken where the track branches to an exit. This may help users locate an exit in conditions of reduced visibility.

Preferably, the track includes symbols, markings or words to indicate where the track branches to an exit. In this way, people following the track along the aisle are provided with an advance warning as they approach an exit and, on reaching the position where the track branches, are directed towards the exit.

The size and/or spacing of the markings may alter as the position where the track branches is approached to provide a visual warning of the proximity of the exit. For example, symbols such as arrows may become smaller and more closely spaced together nearer the exit.

Alternatively, or additionally, the position of an exit may be indicated by a change in colour of the light emitted by the photoluminescent material. For example, the emitted light may be yellow along the aisle and change to orange, red or green where the track branches to an exit.

As a result, a positive indication of the route to an exit is provided which can be followed with confidence thereby assisting the smooth flow of people towards the exit and reducing congestion. In this way, evacuation of the aircraft is facilitated in a simple and effective manner. This is particularly important in an emergency where people may be confused and start to panic if they cannot find their way to an exit

Preferably, the photoluminescent material is protected by a cover of light transmissive material, for example a transparent or translucent plastics material such as polycarbonate, that allows light to pass through both to activate the photoluminescent material and to illuminate the escape route.

The plastics material is preferably also resistant to cleaning fluids or other liquids which may come into contact with the track. The plastics material may also be fire resistant to reduce or prevent the generation of smoke or hazardous fumes. The plastics material may also be given a surface hardening treatment on at least that surface arranged to transmit light so as to increase the resistance to damage, especially scratching, which may impair the emission of light from the photoluminescent material.

In a preferred arrangement, the cover is provided by an outer casing and the photoluminescent material is provided by an insert housed in the casing which surrounds and protects the insert from damage by loads applied to the track such as people treading on the track.

The photoluminescent insert preferably comprises a base strip provided on at least one side with a layer of photoluminescent material and an optional UV protective cover layer on top of the photoluminescent layer. A light coloured base layer may be provided under the photoluminescent layer.

The base strip may be made of any material suitable for application of the photoluminescent material, for example metal, alloy, plastics or composites of these. In a preferred arrangement, the base strip is made of aluminium or aluminium alloy. By the use of a metallic base strip, the insert can be made relatively thin which in turn allows the depth of the housing to be kept to a minimum.

As a result, the track may be produced with a low profile which enables the same track to be used in areas with different types and thicknesses of floor coverings butted up to the edges of the track. The track may also be used in areas with no floor covering at all where the low profile does not create a hazard to trip a person.

The casing may comprise two parts for assembly together with the photoluminescent insert located therebetween. For example, one part may be a base member for mounting the track in its position of use and the other part may be a cover member attached to the base member with the photoluminescent insert located and retained therebetween.

The base and cover members may be permanently secured together during assembly of the track by any suitable means such as adhesive or welding. More preferably, however, the base and cover members are releasably connected together. For example, the base and cover members may have interengageable formations for push or snap fit together during assembly of the track.

By releasably connecting the two parts of the track in this way, if the cover member is worn or damaged in service, it can be removed with the base member and insert in situ and a replacement cover member can be fitted allowing the track to be repaired with minimum delay and disruption. In this way, cost savings can be made for maintenance of the track.

There can be occasions, however, when it is more convenient to replace the entire track, for example during refurbishment of an aircraft, and in these circumstances the photoluminescent insert may be recovered and re-used. This may allow further cost savings to be made.

The assembly of the base member and removable cover member can, however, provide traps for dirt or liquid to collect which may add to maintenance costs by increasing the time spent in cleaning the track.

We therefore prefer to form the outer casing integrally in one piece to provide a unitary housing for the photoluminescent insert.

Thus, from another aspect of the present invention, there is provided a photoluminescent track for an emergency lighting system

comprising an elongate outer casing and an elongate photoluminescent insert extending lengthwise of the outer casing, the insert having a first side and a second side and having photoluminescent material on at least one of said first and second sides, and the outer casing having opposed main walls extending between and integral with opposed side walls with the main walls overlying the first and second sides of the insert, and at least the main wall of the outer member overlying the photoluminescent material being light transmissive.

By this arrangement, the insert is surrounded and protected within the outer casing along the length of the track, and the integrally formed main and side walls of the outer casing substantially eliminate traps for dirt and liquid thereby facilitating cleaning of the track.

The outer casing may be formed separate from the photoluminescent insert with the main walls and side walls of the housing defining a longitudinally extending slot in which the photoluminescent insert is received. Thus, the outer casing may be formed by extrusion or moulding and the photoluminescent insert may be slidable lengthwise of the slot for push-fitting from one end of the slot.

The outer casing may be formed with the slot open at both ends so that the photoluminescent insert can be inserted from either end with both ends of the slot being closed by attaching a respective closure.

Alternatively, the outer casing is formed with the slot open at one end and closed at the other end so that the photoluminescent insert

can be inserted from one end only which is then closed by attaching a closure.

The closure may comprise an end cap which may be released or a membrane which may be ruptured to open the slot when desired. In this way, the photoluminescent insert can be removed and re-used when the track is replaced.

In an alternative arrangement, the outer casing is formed integrally with the photoluminescent insert. Thus, the outer casing may be formed by extrusion or moulding onto the photoluminescent insert. In this way. the insert and outer casing are permanently united.

The various types of track above-described may be retro-fitted to an aircraft after manufacture either to provide an emergency lighting system or to replace an existing emergency lighting system. Alternatively or additionally, the track may be fitted as original equipment during manufacture of an aircraft.

Where the track is fitted as original equipment. it may be pre-assembled to components for assembly of the aircraft. For example, for installation of the track on the floor of an aircraft, it is envisaged that the track may be attached to the floor panels for assembly of the aircraft.

Thus, according to yet another aspect of the present invention, there is provided a component for use in the construction of an aircraft wherein the component is provided with a photoluminescent track to define an escape route in the assembled aircraft.

The track may be manufactured in pre-determined lengths corresponding to the size of the floor panels. In this way. the track is built-in during assembly of the aircraft and a separate assembly operation to install the emergency lighting system is avoided.

In use of the track, the surface of the outer casing which in use is outermost and transmits the light emitted by the photoluminescent material of the insert is exposed and susceptible. especially when mounted on the floor, to being scratched, scuffed. worn or otherwise damaged in service.

As a result. it may be necessary to repair or replace a track which has been damaged outside the normal service or maintenance schedule for the aircraft. Substantial costs may be incurred if an aircraft has to be taken out of service while such repairs are effected, especially if suitable spare parts are not readily available for fitment.

We may therefore prefer to provide a track which can be fitted either way up with the photoluminescent material arranged to emit light through that surface of the track which is outermost.

Accordingly, in another aspect, the present invention provides an emergency lighting system in or for an aircraft comprising guide means including an elongate track including a photoluminescent insert capable of emitting visible light to identify an escape route wherein the track can be fitted either way up with the photoluminescent insert arranged to identify the escape route.

By this arrangement, a track which is damaged in service can be repaired by removing and re-fitting the damaged track the other way up so that the side which was outermost originally and has been damaged is now innermost and the side which was innermost originally is now outermost. In this way, a repair can be effected simply and easily in situ using the existing track thereby eliminating delays caused when a suitable spare part is not to hand and has to be obtained specially.

Preferably, the track comprises an elongate outer casing in which the photoluminescent insert is housed. The photoluminescent insert may be provided with photoluminescent material on one side only with the insert being removable from the casing.

In this way, the orientation of the insert can be reversed when the casing is fitted the other way up so that the photoluminescent material is capable of emitting visible light through that side of the casing which is outermost in both the original and reversed positions of the track. For example, the outer casing may be an extrusion or moulding of plastics material with an elongate longitudinal slot in which the photoluminescent material is received as described previously.

Alternatively, the photoluminescent insert may be provided with photoluminescent material on both sides so as to be capable of emitting visible light through that side of the casing which is outermost without requiring the orientation of the insert to be reversed.

In this arrangement, the photoluminescent insert may be incorporated into the outer casing to provide an integrated unitary construction. For example, the photoluminescent insert may be incorporated by moulding or extruding the outer casing onto the insert so that the insert is permanently attached to the casing.

Thus, according to another aspect of the present invention, there is provided an emergency lighting system in or for an aircraft comprising an elongate track capable of emitting visible light to indicate an escape route, the track including an insert extending lengthways of the track, the insert being provided with photoluminescent material on each side, and an outer casing of light transmissive material covering each side of the insert, the casing being capable of mounting either way up to present a selected one of the first and second sides of the insert for the emission of visible light.

Preferably, the track is substantially symmetrical about a plane through the insert parallel to the longitudinal direction. In this way, the track can be fitted either way up without modification to the surrounding structure.

Advantageously, the insert comprises a support or base strip coated on each side with photoluminescent material having suitable after-glow properties, for example zinc sulphide or strontium aluminate. The base strip may be made of any suitable material but is preferably made of metal, for example aluminium.

Thus, the insert may comprise a base strip of aluminium having a thickness of preferably not more than 2mm, more preferably not

more than 1mm and most preferably 0.66mm or less. In a preferred construction, a strip of aluminium foil is employed but it will be understood, however, that other materials may be employed to support the photoluminescent material.

The photoluminescent material of the insert may be overcoated with a UV protective layer to prevent degradation of the photoluminescent material. Additionally, or alternatively, the light transmissive material may provide UV protection for the photoluminescent material of the insert. The light transmissive material may be adapted to provide any desired characteristics for the intended application, for example fire resistance.

Preferably, the track is formed integrally in one piece with the insert integrated in the casing. For example, the casing may be moulded or co-extruded onto the insert. In this way, the insert may be encapsulated within the casing. As a result, ingress of dirt or moisture is prevented.

According to a still further aspect of the present invention, there is provided a photoluminescent insert for an emergency lighting system in an aircraft comprising an elongate support strip provided on each side with photoluminescent material.

Advantageously, the insert is embedded in a light transmissive plastics material such as polycarbonate to protect the photoluminescent material. For example, the plastics may be co-extruded onto the insert which may be in the form of a metal foil coated on both sides with photoluminescent material.

According to a still further aspect of the present invention, there is providing a method of repairing an emergency lighting system in an aircraft wherein the emergency lighting system includes an elongate track arranged to emit visible light photoluminescently from a selected one of two sides of the track, the method including the step of reversing the orientation of the track to emit light photoluminescently from the other side.

Preferably, the photoluminescent emission of light is provided by an insert which may be provided on both sides with photoluminescent material so that the track emits visible light in both orientations. Alternatively, the insert is provided with photoluminescent material on one side only and the method further includes removing and re-fitting the insert the other way up within the track when the orientation of the track is reversed.

The photoluminescent guide means may comprise a single track having any of the constructions above-described extending along the escape route for the user to follow but more preferably, two tracks are provided spaced apart to define therebetween a path along the escape route in which a user can move towards an exit assisted by any symbols, words or markings provided to indicate the shortest route to an exit.

The photoluminescent guide means may be positioned at or near floor level. For example, where rows of seats are arranged on either side of a central aisle with exits at each end and/or between the ends, the photoluminescent guide means preferably extends along the aisle with branches leading from the aisle to the exits. In this way, an escape route is provided from any position along the aisle to

any exit with the nearest exit being identified by the presence of appropriate symbols, words or markings.

In a preferred arrangement, tracks are provided on the floor on each side of the aisle adjacent to the seats so as to emit a substantially continuous path of light along both sides of the aisle leading to an exit from any row of seats within the cabin. Providing tracks on each side of the aisle delimits a path between the seats in which people can move towards an exit without being trapped between rows of seats.

In a particularly preferred arrangement, each track is arranged to extend below the armrest of the adjacent seat on that side of the aisle. More especially, the inner edge of the track adjacent to the aisle is located substantially perpendicular to the outer edge of the armrest.

In this way, the track is positioned outside the area trodden on by people as they walk along the aisle and/or exposed to the wheels of trolleys pushed along the aisle under normal conditions of use. As a result, the track is less susceptible to damage and service life may be extended.

The position of the track below the armrests is chosen to protect the track from wear and tear in service while providing sufficient exposure of the photoluminescent material to ambient light and/or from overhead ceiling lighting employed for normal lighting to activate the photoluminescent material.

In addition to providing the photoluminescent guide means at or near floor level, photoluminescent guide means is preferably also provided at or near ceiling level. The guide means at or near the ceiling is preferably a mirror image of the guide means at or near the floor and may be of similar construction and/or may include similar symbols, words or markings to indicate the direction to the nearest exit.

Thus, from another aspect, the present invention provides an emergency lighting system in or for an aircraft having rows of seats arranged on either side of an aisle, the system comprising low level photoluminescent guide means operable to identify an escape path at or near floor level and high level photoluminescent guide means arranged to identify an escape path at or near ceiling level, the photoluminescent guide means being arranged to assist evacuation of the aircraft by a person moving along the aisle between the rows of seats to an exit.

By providing the photoluminescent guide means at both low and high levels, at least one of the guide means will usually be available for the user to follow. For example, if visibility of the high level guide means is obscured or blocked by smoke, the user can follow the low level guide means below the smoke level. Alternatively, if visibility of the low level guide means is obscured or blocked by water, the user can follow the high level guide means.

Each row of seats may be provided by a demountable multi-seat unit on each side of the aisle allowing the number and arrangement of seats to be altered. For example, seat units comprising two, three or four seats may be provided. These units are normally of different

width with the result that the width of the aisle between seat units on each side can change when one seat unit is replaced by another seat unit with more or less seats.

This can lead to problems where the emergency lighting system is provided by a floor mounted track. In particular, the position of the floor mounted track is fixed on installation of the emergency lighting system and, if the seating layout is later changed by fitting a wider seat unit, this may extend over the track so that the escape path is concealed.

Accordingly, we prefer to provide the seat units with a photoluminescent track on the side of the aisle seat, preferably close to the floor. The track on the aisle seats is provided in addition to the existing floor track and will provide an escape route for passengers to follow where the floor track is concealed by the seat unit. In this way, the appearance of a substantially continuous track along each side of the aisle leading to an exit may be maintained without modification to the floor track.

Thus, from another aspect of the present invention, there is provided in or for an aircraft having rows of seats on each side of an aisle and a photoluminescent track extending along each side of the aisle at or near floor level, at least one row including a demountable multi-seat unit on at least one side of the aisle such that the width of the aisle may be altered by fitting any selected one of a plurality of demountable multi-seat units of different width, wherein a photoluminescent track is provided on that side of the multi-seat unit which, in use, is arranged adjacent to the aisle.

Preferably, the track includes photoluminescent material such as zinc sulphide or strontium aluminate overlaid by a cover of transparent or translucent material attached to the seat unit to locate and retain the photoluminescent strip in place. The photoluminescent material may be provided by any of the photoluminescent inserts previously described.

Other features, benefits and advantages of the invention in each of its aspects will be more fully understood from the description later herein of exemplary embodiments.

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings wherein:-

Figure 1 is a cross-sectional view of the interior of the cabin of a passenger aircraft fitted with ceiling and floor mounted photoluminescent guide means embodying the present invention;

Figure 2 shows a section through a track of the guide means shown in Figure 1;

Figure 3 shows a detail of the floor mounted photoluminescent guide means of Figure 1;

Figure 4 shows an exit provided with photoluminescent indicator and sign means embodying the present invention;

Figure 5 shows a section through an alternative track suitable for use in the present invention;

Figure 6 is a side view of the track shown in Figure 5;

Figure 7 is a plan view of the track shown in Figure 5;

Figure 8 is an enlarged cross-section of the insert of the track shown in Figure 5;

Figures 9a through 9e are perspective views of one end of the track shown in Figures 5 to 8 depicting the method of assembly;

Figure 10 shows a section through another track suitable for use in the present invention;

Figures 11a through 11f show examples of various marker symbols that can be incorporated in the track of the present invention;

Figures 12a through 12d are perspective views showing the method of attaching the marker symbols to the track;

Figure 13 shows schematically the general arrangement of the emergency lighting system in an aircraft having interchangeable seat units; and

Figure 14 shows a detail of the aisle seat of an interchangeable seat unit for the emergency lighting system of Figure 13.

Referring first to Figures 1 to 4 of the accompanying drawings, Figure 1 shows a typical arrangement of seating in the interior of a cabin 1 of a passenger aircraft. The seats 2 are arranged in rows 3 (only one shown) on opposite sides of a central aisle 4. In this embodiment, six seats 2a through 2f are shown in each row 3 arranged in two groups of three on opposite sides of the central aisle 4. This is not essential however and it will be understood that the number and arrangement of seats in each row may be varied while providing a central aisle separating groups of seats in each row for access in the direction of the length of the cabin.

An overhead electrical lighting system (not shown) is installed in the ceiling of the cabin 1 above the seats 2 for illumination of the cabin 1 under normal conditions. In an emergency, for example following a crash landing or aborted take-off, the ceiling lighting system may be inoperable due to impact damage to the structure of the aircraft or by fire or by water. The ceiling lighting system may also be rendered ineffective or obscured by the presence of smoke in the cabin 1 following outbreak of a fire.

In this embodiment, photoluminescent guide means 5 is provided to assist evacuation of the aircraft in the event the normal overhead electrical lighting system fails or is blocked by smoke. The guide means 5 comprises a floor mounted emergency lighting system 6 and a ceiling mounted emergency lighting system 7 each comprising two tracks 6a, 6b and 7a, 7b incorporating photoluminescent material such as strontium aluminate.

The floor mounted tracks 6a, 6b are arranged on either side of the central aisle 4 and identify an escape route at floor level extending the length of the cabin 1 between the seats 2 on opposite sides of the aisle 4.

The ceiling mounted tracks 7a, 7b are arranged to be a mirror image of the floor mounted tracks 6a, 6b and identify an escape route at ceiling level extending the length of the cabin 1 between storage compartments 8a. 8b positioned above the seats 2 on each side of the cabin 1.

In this embodiment, the tracks 6a,6b and 7a,7b are of similar construction but this is not essential, for example the ceiling tracks 7a,7b are not subjected to the same wear and tear as the floor tracks 6a,6b and this may allow the use of a less robust construction for the ceiling tracks 7a,7b compared to the floor tracks 6a,6b.

As shown in Figure 2, each track 6a,6b and 7a,7b has a photoluminescent insert 9 housed in an outer casing 10 formed by a base member 11 for mounting on the floor/ceiling and a cover member 12 for protecting the insert 9.

The photoluminescent insert 9 comprises one or more base layers of vinyl containing a whitening agent such as titanium dioxide, overlaid by one or more layers of vinyl containing photoluminescent material such as strontium aluminate and a UV protective top layer.

The base member 11 and cover member 12 are extrusions of plastics such as polycarbonate. The cover member 12 at least is transparent or translucent so that light can pass through. In this way, the

photoluminescent material of the insert 9 is activated by exposure to natural or artificial light, and light emitted by the photoluminescent material illuminates the escape path in conditions where the illumination from either natural light or the normal ceiling lighting is low or absent.

The strontium aluminate employed as the photoluminescent material emits a yellow light tinged with green but it will be understood that the colour may be altered depending on the materials employed. Generally, yellow is preferred, however, as providing a visible glow at low levels of natural lighting.

It will also be understood that the base member 11 and/or cover member 12 may be made from other materials and that the shape and configuration of the base member 11 and/or cover member 12 may be altered from that shown to change the shape of the casing 10 to suit any given application.

The base member 11 and cover member 12 may be permanently secured together, for example by ultrasonic welding. More preferably, however, the base member 11 and cover member 12 are releasably connected, for example by interengageable formations (not shown) which may be a press or snap fit, so that the casing 10 can be assembled and dis-assembled.

In this way, if the cover member 12 is damaged in service, a replacement cover member 12 can be fitted without removing and replacing the whole track. Additionally, the photoluminescent material of the insert 9 is relatively expensive and, when the track is

replaced, for example during a refurbishment of the aircraft, the insert 9 can be recovered and re-used if desired.

The tracks 6a,6b and 7a,7b may each be provided as a single section of the required length. More preferably, however, the tracks 6a,6b and 7a,7b are provided by a plurality of track sections of shorter length laid end to end to produce the required length. The sections may be formed in a range of standard lengths, for example 1 or 2 metres, which can be used to produce tracks 6a,6b and 7a,7b of any desired length and shape to suit the layout of the seats and exits in a particular aircraft.

The aircraft is provided in known manner with doors 13 (Figure 4) at the front and rear ends of the cabin 1 through which passengers can board and leave the aircraft under normal conditions. These doors 13 can also be used as exits in an emergency.

The aircraft is also provided with a doors 14 positioned midway between the ends of the cabin 1 on opposite sides of the aisle 4, usually over the wings for use as exits in an emergency only. Access to these centrally positioned doors 14 is normally provided between two rows of seats 2.

The floor mounted guide tracks 6a,6b are arranged to identify an escape route at floor level leading from a seat 2 at any position within the cabin 1 to each of the exit doors which can be opened in an emergency for passengers to leave the aircraft. For example Figure 3 shows the arrangement of the guide tracks 6a,6b to identify the overwing exits on each side of the aisle 4. As shown, in the vicinity of the exits, the floor mounted tracks 6a,6b extending along

the cabin 1 are arranged to extend from the centre aisle 4 to the exits. The corresponding ceiling mounted guide tracks 7a,7b preferably also extend from the centre aisle 4 to the exits in similar manner.

To help movement of passengers towards the exits, the tracks 6a,6b and 7a,7b incorporate markings such as arrows 15 pointing in the direction of the nearest exit and/or words 16 such as 'EXIT' to identify the shortest route for passengers to follow.

The markings 15,16 may be rendered visible by blocking the light emitted from the photoluminescent inserts 9. For example, the markings 15,16 may be printed on the cover member 12, preferably on the inside face so as to be protected from possible damage, especially by people treading on the floor mounted track 6. More preferably, the markings 15,16 are applied to the strips 9 of photoluminescent material themselves.

Alternatively, the markings 15,16 may be provided by the use of dyes which also glow in the dark with a distinctive colour different to that of the photoluminescent material.

The provision of markings 15,16 as part of the emergency lighting systems 6,7 which act to guide passengers from their seats to the nearest exit is important in an emergency situation where the interior of the cabin 1 may be in darkness following failure of the normal electrical lighting system and vision may be further restricted by smoke from a fire.

Thus, the light emitted by the tracks 6a,6b and 7a,7b due to their photoluminescence not only identifies the escape route in darkness but will have a calming effect thereby reducing the panic and confusion caused by an accident and assisting passengers to find their way to an exit with confidence so that the time for evacuation may be reduced. This can be crucial in an emergency situation where a saving of a few seconds may make the difference between life and death.

To this end, as shown in Figure 4, the present invention further provides photoluminescent indicator means 17 to identify the location of each exit door 13 and photoluminescent sign means 18 to identify the instructions and controls for opening each exit door 13. It will be understood that each exit door 14 would be provided with similar indicator means 17 and sign means 18.

Thus, it is important in an emergency situation that the exit doors 13,14 are clearly identifiable, and that the location and operation of the controls for opening the exit doors 13,14 is clearly indicated so that the exit doors 13,14 can be opened easily by a passenger who may be in a panic and confused, and who may not be familiar with the controls.

In addition, it is important, that the exit doors 13,14 remains clearly identifiable after they have been opened so that any other passengers finding their way to the vicinity of the exit doors 13,14 can escape. Again, any unnecessary delay in finding and/or opening the exit doors 13,14 may be the difference between life and death in an emergency situation.

The indicator means 17 for identifying the exit door 13 includes photoluminescent material and, as shown in Figure 4. extends around the exit door 13 on the wall of the cabin 1. In this way, the position of the exit door 13 is identified by the light emitted by the photoluminescent material and can be seen by passengers approaching the exit both when the exit door 13 is closed and after it has been opened. This is extremely important for passengers who are seated away from an exit and are not first to reach and open the exit door 13.

The indicator means 17 may be applied to the wall of the cabin 1 as paint or tape incorporating the photoluminescent material with an optional transparent or translucent cover (not shown) overlaid to protect the photoluminescent material. Alternatively, the indicator means 17 may be attached to the wall of the cabin 1 as a track similar to the emergency lighting systems 6,7 described previously.

The indicator means 17 may extend around the exit door 13 as shown. Alternatively, the indicator means 17 may be provided on one or both sides of the exit door 13. In the latter case. it is preferred that the indicator means 17 extends to a height of at least four feet. The photoluminescent material may be arranged to emit any desired pattern of light. for example broken or unbroken.

The position of each exit door 13 is further indicated by the provision of photoluminescent markings 19 such as the words 'EXIT' on the door 13 and/or on the wall of the cabin 1 on either side of the door 13, the latter again still being visible after the door 13 has been opened.

The markings 19 may be of any suitable size and shape and may be provided at the top and/or bottom of both the door 13 and the surrounding wall of the cabin 1 so as to be visible at both floor and ceiling level. The markings 19 may be applied in any suitable way, for example with photoluminescent paint on a panel 20 providing a contrasting background for enhanced visibility and optionally overlaid with a transparent or translucent protective cover.

The sign means 18 for identifying the instructions and controls for opening the exit door 13 includes a graphic symbol such as a photoluminescent arrow 21 positioned behind an operating handle 22 to indicate the direction on which the handle 22 must be moved to release and open the exit door 13. The arrow 21 may be applied in any suitable way such as with photoluminescent paint which may be overlaid with a transparent or translucent protective cover.

The handle 22 may also be photoluminescent for enhanced visibility. for example photoluminescent paint may be applied to the handle 22. Alternatively, the handle 22 may be provided with a photoluminescent insert 23. The photoluminescence applied to the handle 22 may also be in the form of a graphic symbol such as an arrow to indicate the direction of opening.

The sign means 18 further includes a panel 24 on which opening instructions for the door 13 may be printed with photoluminescent ink and preferably overlaid with a transparent or translucent protective cover. The panel 24 is located adjacent to the handle 22 and may assist location of the handle 22.

The indicator means 17 and sign means 18 above-described would be provided at each of the exits and may be altered to suit the location and/or operation of the particular exit door 13,14.

As will now be appreciated, the embodiment above-described provides a fully integrated photoluminescent emergency lighting system for assisting evacuation of an aircraft in an emergency which does not require any electrical power source and which continues to provide a visual indication of an escape path even if damaged locally, for example by a fire.

It will also be understood that the invented photoluminescent emergency lighting system can be installed either as original equipment when fitting out a new aircraft or to replace an existing electrically powered emergency lighting system when refurbishing an existing aircraft. Where the system is retro-fitted to an existing aircraft, the tracks 6,7 may be adapted to replace and cover the original floor and ceiling electrical emergency lighting systems so as to avoid or reduce any major changes to the structure of the aircraft.

Referring now to Figures 5 to 9 there is shown an alternative track 30 which could be employed in the floor and ceiling emergency lighting systems 6,7 above-described. The track 30 comprises an elongate outer casing 31 of uniform, generally rectangular cross-section housing an elongate insert 32 containing photoluminescent material such as zinc sulphide or strontium aluminate.

The casing 31 is a one-piece moulding of a rigid transparent or translucent plastics such as polycarbonate which transmits light both to activate the photoluminescent material and to allow light emitted

by the photoluminescent material to be seen. The plastics may also be fire resistant.

The casing 31 has flat upper and lower main walls 31a and 31b respectively connected by opposed side walls 31c,31d to define therebetween a substantially rectangular slot 33 in which the insert 32 is received.

As best shown in Figure 8, the insert 32 comprises a base strip 32a covered on one side by at least one layer 32b of photoluminescent material overlaid with a UV protective layer 32c of clear plastics or lacquer.

The insert 32 extends the length of the slot 33 and has a width 'w' and thickness 't' slightly less than the corresponding dimensions of the slot 33 to provide limited clearance for push-fitting the insert 32 in the slot 33 from one end of the casing 31.

In this embodiment, the insert 32 is sufficiently rigid by virtue of forming the base strip 32a from sheet metal such as aluminium to allow push fitting for any length of casing 31. It will be understood that the base strip 32a may be formed from any material which allows push fitting the insert 32.

The insert 32 is enclosed and surrounded by the casing 31 and the slot 33 is closed at each end by a respectively end cap 34. Each end cap is similar and comprises a face plate 34a sized to match the cross-section of the casing 31 and an integral tongue 34b sized to fit within the slot 33 below the insert 32.

As best shown in Figures 9a through 9e, the end caps 34 are secured to opposite ends of the casing 31 by locating the tongue 34b underneath the end of the insert 32 within the slot 33 and applying a continuous bead 35 of sealant adhesive to bond the face plate 34a to the end of the casing 31. In this way, the slot 33 is sealed to encapsulate and protect the insert 32 in the casing 31.

The end caps 34 are constructed and assembled so as not to increase significantly the length of the casing 31 or block the light emitted by the insert 32. As a result, when adjacent track sections 30 are butted together, the inserts 32 emit a substantially continuous path of light. The dimensions of the casing 31 and insert 32 are chosen so that the insert emits light over a major part, preferably at least 75% and more preferably at least 90%, of the outer surface of the wall 31a of the casing 31 overlying the photoluminescent material.

The casing 31 and insert 32 are pre-assembled to form track sections of pre-determined length, for example 1 or 2 metres. Several track sections can be laid end to end and also cut into shorter lengths for fitment in the appropriate combination to produce any desired length and shape of emergency lighting track 30 to suit the layout of the seats and exits in a particular aircraft.

If a pre-assembled track section has to be cut to a shorter length, the insert 32 is first removed by prising off one of the end caps 34 and sliding the insert 32 out of the slot 33. The casing 31 and insert 32 are then cut to the required length, re-assembled and an end cap 34 fitted to close the end of the slot 33.

The use of aluminium sheet for the base strip 32a of the insert 32 has advantages over the vinyl base employed for the insert 9 of the previous embodiment. In particular, adhesion of the layer 32b of photoluminescent material is improved and chemical interaction between the insert 32 and the casing 31 is eliminated or significantly reduced. Furthermore, the fire resistance and/or smoke generation characteristics of the insert 32 are improved. In addition, the strength/rigidity required for push-fitting the insert 32 can be achieved with relatively thin sheet material allowing the track 30 to be produced with a low profile.

The photoluminescent insert 32 extends the length of the casing 31 such that, when track sections are laid end to end the light emitted by the photoluminescent material is substantially unbroken by the presence of the end caps 34 and provides a continuous cue from any point along the aisle to an exit. The track sections may be provided with symbols or markings to assist movement of passengers towards an exit in similar manner to the previous embodiment.

Turning now to Figure 10. there is shown another alternative track 40 which can be used in the floor and ceiling emergency lighting systems 6,7 above-described. The track 40 has an integrated monocoque structure comprising an outer casing 41 of light transmissive material housing an insert 42 containing photoluminescent material such as strontium aluminate.

The insert 42 comprises a thin, flat base strip of metal foil such as aluminium coated on each side 43,44 with strontium aluminate and optionally overlaid with a UV protective top layer. The casing 41 is a substantially rectangular extrusion of polycarbonate with generally

flat outer surfaces 45,46 on each side. The length and width of the insert 42 is such that a major part, preferably at least 75% and more preferably at least 90%, of the outer surface 45,46 on each side of the track 40 is illuminated by the photoluminescent material of the insert 42.

In this embodiment, the insert 42 has a thickness of 0.14mm to 0.20mm and a width of 29.0mm to 30.5mm. The casing 41 has a thickness of 4.14mm to 4.50mm and a width of approximately 36.00mm. As will be appreciated, the use of aluminium foil as the base for the photoluminescent material produces a track 40 which is relatively thin and lightweight. In this way, the track can be fitted in both carpeted and non-carpeted areas with advantages for the manufacture and installation of the track 40.

As shown, the track 40 is of rectangular section and is symmetrical about a plane through the insert 42 parallel to the length of the casing 41. In this way, the track 40 can be installed either way up to present either one of the sides 43,44 of the insert 42 outermost for emitting visible light photoluminescently to indicate an escape route in an emergency.

In this way, if the outer surface 45,46 of the outermost side of the casing 41 is scratched, scuffed or otherwise damaged in service so as to detract from the appearance of the track 40 and/or to reduce the visible light emitted photoluminescently by the insert 42, the track 40 can be removed, inverted and re-fitted to position the outer surface 45,46 of the innermost side of the casing 41 outermost and attach the track 40 by the damaged surface which becomes the innermost surface. This enables a simple and effective repair of a

damaged track 40 to be effected in situ without requiring a spare part.

As will be understood, such repair may be effected during the normal turnaround of the aircraft between flights so that the aircraft is not grounded or delayed while repairs are carried out. Typically, the track 40 is secured with double sided adhesive tape which can be easily removed and the surface of the casing 41 cleaned to remove any traces of adhesive without damage to the surface when the track 40 is reversed.

Furthermore, where the track 40 consists of a series of track sections of pre-determined length, for example 1 or 2 metre lengths, butted end to end, individual sections can be reversed independently and the whole track 40 does not have to be reversed when any part is damaged in service. This further simplifies and reduces the time to carry out any repair to the track 40.

It will be appreciated that the benefits and advantages of reversing the track 40 may be achieved with other constructions. Thus, in the previous embodiments, the tracks 6a,6, 7a,7b and 30 can be reversed by removing the insert 9,32, reversing the orientation of the casing 10,31 and re-inserting the insert 9.32 the same way up to emit light through the other side of the casing 10,31 which is to form the outer surface of the track.

With reference to Figures 11 and 12, various types of marker symbols 50 such as arrows, chevrons, words etc for use in the tracks 6a,6b,7a,7b,30, 40 above-described are shown together with the method of attaching the marker symbols 50.

The marker symbols 50 are self-adhesive and are attached to the photoluminescent insert 9,32,42 after removal of a backing film 51 from the lower surface to expose the adhesive. Once applied, a protective application tape 52 is removed from the upper surface to expose the symbol 50.

In this way, symbols 50 can be provided at appropriate positions to indicate the direction to an exit and to identify the position of an exit. The symbols 50 may be made visible by blocking the light emitted the insert 9,32,42 so as to appear dark against an illuminated background. Alternatively, the symbols 50 may be made visible by transmitting light of a different colour to the background.

Turning now to Figures 13 and 14, there is shown a further embodiment of the invention applied to an aircraft 60 having interchangeable demountable seat units 61 of different width.

The aircraft 60 has rows of seats 62 in two sections. In a first section, each row has six seats, three on each side of the main aisle 63. In a second section, each row has four seats, two on each side of the main aisle 63. The first section may be for economy class passengers and the second section for business class passengers.

Each group of three seats in the first section is provided by a demountable multi-seat unit 61a and each group of two seats in the second section is provided by a demountable multi-seat unit 61b. The units 61a are wider than the units 61b and aisle 63 is narrower

between the units 61a in the first section than between the units 61b in the second section.

Photoluminescent tracks 64a,64b extend along each side of the aisle 63 to identify the boundaries of the aisle 63 and define the escape path therebetween. As shown, the escape path is wider in the second section.

As a result, if the wider seat units 61a are fitted in the second section as shown in dotted outline in Figure 13 to increase the capacity of the aircraft 60, the width of the aisle 63 is reduced. This has the effect that the new boundary of the aisle 63 is no longer indicated by the existing tracks 64a,64b which are now obscured by the wider seat units 61a. It will be understood this is but one example of the effect of changing one seating unit for another and that other arrangements and combinations of multi-seat units may give rise to the same problem.

To alleviate this problem without altering the layout of the existing tracks 64a,64b on the floor of the aircraft 60, a photoluminescent track 65 is provided on the side of the aisle seat of the wider seat units 61a which overlie the floor tracks 64a,64b. In this way, the track 65 identifies the boundary of the aisle 63 and defines an escape path between the seat units which the passengers can follow to evacuate the aircraft 60.

As best shown in Figure 14, the aisle seat has a side panel 66 and the track 65 is located on the side facing the aisle at the bottom of the panel 66 close to the floor. The track 65 is formed by photoluminescent material which can be mounted in a frame or

carrier (not shown) releasably attached to the side panel 66 to overlie and protect the photoluminescent material. The frame or carrier may be a moulding of a suitable transparent or translucent material, for example a plastic material such as polycarbonate.

The track 65 extends in the longitudinal direction of the aisle 63 and may be provided with markings or symbols such as arrows or words as described previously. The track 65 can be of different lengths depending on the size and/or shape of the side panel 66 to which it is fitted.

In a modification (not shown), the track 65 is incorporated into the side panel 66, for example the side panel 66 may be provided with a slot or recess to receive the photoluminescent material which may be in the form of an insert similar to those described previously herein.

It will be appreciated that the exemplary embodiments described herein are intended to illustrate the diverse range and application of the invention to different situations and that features of the embodiments may be employed separately or in combination with any other features of the same or different embodiments to produce any desired system of emergency lighting.

It will also be understood that while the specific materials and/or configuration of the various parts of the emergency lighting system described and illustrated are believed to represent the best method currently known to the applicant, it will be understood that the invention is not limited thereto and that various modifications and improvements can be made within the spirit and scope of the claims.

For example, the photoluminescent material employed in the various examples of the invention may be of any type providing an acceptable level of illumination for a sufficient period of time.

Finally, although the invention has been described with particular reference to the provision of an emergency photoluminescent lighting system in an aircraft, it will be appreciated by those skilled in the art that the invention also has application to other mass transportation carriers, such as ships, trains, coaches and the like where there is a need to be able to evacuate large numbers of people as quickly as possible in an emergency situation and the invention is deemed to include all such applications of the invented system.

CLAIMS

1. An emergency lighting system in or for an aircraft comprising photoluminescent guide means operable to identify an escape route leading to an exit, photoluminescent indicator means operable to identify the exit in both open and closed conditions of the exit, and photoluminescent sign means operable to identify instructions and controls for opening the exit.

2. An emergency lighting system according to claim 1 wherein the indicator means includes photoluminescent material such as zinc sulphide or strontium aluminate operable to provide illumination on one or both sides of the exit, more preferably around the exit, in conditions of darkness or low illumination.

3. An emergency lighting system according to claim 2 wherein the photoluminescent material is covered by a light transmissive plastics material such as polycarbonate.

4. An emergency lighting system according to claim 2 or claim 3 wherein the photoluminescent material is provided in the form of an insert, self-adhesive tape or paint.

5. An emergency lighting system according to any preceding claim wherein the indicator means includes a word and/or symbol identifying the exit photoluminescently.

6. An emergency lighting system according to claim 5 wherein the word 'exit' and/or a symbol of a door is provided on the door or

surrounding structure, preferably in photoluminescent material on a contrasting background or vice versa.

7. An emergency lighting system according to any preceding claim wherein the photoluminescent sign means include a symbol such as an arrow behind a door handle to indicate photoluminescently the direction in which the handle must be turned to open the door.

8. An emergency lighting system according to claim 7 wherein the arrow is photoluminescent on a contrasting background.

9. An emergency lighting system according to claim 7 or claim 8 wherein the handle is photoluminescent.

10. An emergency lighting system according to any of claims 7 to 9 wherein the operating instructions are photoluminescent, for example printed with photoluminescent ink on a contrasting background.

11. An emergency lighting system according to any preceding claim wherein the photoluminescent guide means is in the form of at least one track incorporating photoluminescent material such as zinc sulphide or strontium aluminate which is operable to illuminate the escape route in conditions of darkness or low illumination.

12. An emergency lighting system according to claim 11 wherein the track includes symbols, words or other suitable markings separately or in any combination to indicate the direction to the

nearest exit, for example, the track may include symbols like arrows and/or words such as exit to assist escape in an emergency.

13. An emergency lighting system according to claim 11 or claim 12 wherein the track is provided in a continuous section.

14. An emergency lighting system according to claim 11 or claim 12 wherein the track is provided by a plurality of separate sections laid end to end.

15. An emergency lighting system according to any of claims 11 to 14 wherein the photoluminescent material is substantially continuous along the track.

16. An emergency lighting system according to any of claims 11 to 14 wherein the photoluminescent material is provided at spaced intervals along the track.

17. An emergency lighting system according to any of claims 11 to 14 wherein a combination of continuous and broken regions of photoluminescent material is employed to indicate the position of an exit, for example, the photoluminescent material may be continuous along the aisle and broken where the track branches to an exit.

18. An emergency lighting system according to any of claims 11 to 17 wherein the position of an exit is indicated by a change in colour of the light emitted by the photoluminescent material.

19. An emergency lighting system according to any of claims 11 to 18 wherein the photoluminescent material is protected by a cover

of light transmissive material, for example a transparent or translucent plastics material such as polycarbonate, that allows light to pass through both to activate the photoluminescent material and to illuminate the escape route and is preferably resistant to cleaning fluids or other liquids which may come into contact with the track and/or is fire resistant to reduce or prevent the generation of smoke or hazardous fumes and/or is optionally given a surface hardening treatment on at least that surface arranged to transmit light.

20. An emergency lighting system according to claim 19 wherein the cover is provided by an outer casing and the photoluminescent material is provided by an insert housed in the casing which surrounds and protects the insert.

21. An emergency lighting system according to claim 20 wherein the photoluminescent insert comprises a base strip, for example of metal such as aluminium, provided on at least one side with a layer of photoluminescent material and optionally a UV protective cover layer on top of the photoluminescent layer and/or a light coloured base layer under the photoluminescent layer.

22. An emergency lighting system according to claim 20 or claim 21 wherein the casing comprises two parts for assembly together with the photoluminescent insert located therebetween, for example a base member for mounting the track in its position of use and a cover member attached to the base member with the photoluminescent insert located and retained therebetween.

23. An emergency lighting system according to claim 22 wherein the two parts of the casing are permanently secured together during assembly of the track, for example by adhesive or welding.

24. An emergency lighting system according to claim 22 wherein the two parts are releasably connected together, for example by interengageable formations for push or snap fit together during assembly of the track.

25. An emergency lighting system according to claim 20 or claim 21 wherein the outer casing is formed integrally in one piece to provide a unitary housing for the photoluminescent insert.

26. An emergency lighting system according to claim 25 wherein the photoluminescent insert has a first side and a second side and has photoluminescent material on at least one of said first and second sides, and the outer casing has opposed main walls extending between and integral with opposed side walls with the main walls overlying the first and second sides of the insert, and at least the main wall of the outer member overlying the photoluminescent material is light transmissive.

27. An emergency lighting system according to claim 26 wherein the outer casing is formed separate from the photoluminescent insert with the main walls and side walls of the housing defining a longitudinally extending slot in which the photoluminescent insert is received, for example, the outer casing may be formed by extrusion or moulding and the photoluminescent insert may be slidable lengthwise of the slot for push-fitting from one end of the slot.

28. An emergency lighting system according to claim 27 wherein the slot is formed with at least one end open for insertion of the insert and said open end is closed by attaching a closure, for example an end cap or a membrane.

29. An emergency lighting system according to claim 20 or claim 21 wherein the outer casing is formed integrally with the photoluminescent insert, for example the outer casing may be formed by extrusion or moulding onto the photoluminescent insert.

30. An emergency lighting system according to any of claims 11 to 29 wherein the track can be retro-fitted to an aircraft after manufacture either to provide an emergency lighting system or to replace an existing emergency lighting system or the track can be fitted as original equipment during manufacture of an aircraft.

31. An emergency lighting system according to claim 30 wherein the track can be pre-assembled to components for assembly during manufacture of an aircraft, for example, the track may be attached to floor panels for installation of the track on the floor of an aircraft.

32. An emergency lighting system according to claim 31 wherein the track is formed in pre-determined lengths corresponding to the size of the floor panels.

33. An emergency lighting system according to any of claims 11 to 32 wherein the track can be fitted either way up with the photoluminescent material arranged to emit light through that surface of the track which is outermost.

34. An emergency lighting system according to claim 33 wherein the photoluminescent insert is provided with photoluminescent material on one side only and is removable from the casing for reversing the orientation when the casing is fitted the other way up.

35. An emergency lighting system according to claim 33 wherein the photoluminescent insert is provided with photoluminescent material on both sides so as to be capable of emitting visible light through that side of the casing which is outermost whichever way up the casing is fitted.

36. An emergency lighting system according to claim 35 wherein the photoluminescent insert is incorporated into the outer casing to provide an integrated unitary construction.

37. An emergency lighting system according to claim 35 or claim 36 wherein the track is substantially symmetrical about a plane through the insert parallel to the longitudinal direction.

38. An emergency lighting system according to claim 36 wherein the insert comprises a support or base strip coated on each side with photoluminescent material and optionally overcoated with a UV protective layer to prevent degradation of the photoluminescent material.

39. An emergency lighting system according to claim 38 wherein the insert comprises a base strip of metal such as aluminium having a thickness of preferably not more than 2mm, more preferably not more than 1mm and most preferably 0.66mm or less.

40. An emergency lighting system according to claim 38 or claim 39 wherein the insert comprises a base strip of aluminium foil.

41. An emergency lighting system according to any of claims 11 to 40 wherein the photoluminescent guide means comprises at least one track extending along the escape route for the user to follow towards an exit.

42. An emergency lighting system according to any of claims 11 to 41 wherein two tracks are provided spaced apart to define therebetween a path along the escape route in which a user can move towards an exit.

43. An emergency lighting system according to any of claims 11 to 42 wherein the photoluminescent guide means is positioned at or near floor level, for example, where rows of seats are arranged on either side of a central aisle with exits at each end and/or between the ends. the photoluminescent guide means preferably extends along the aisle with branches leading from the aisle to the exits.

44. An emergency lighting system according to claim 43 wherein tracks are provided on the floor on each side of the aisle adjacent to the seats so as to emit a substantially continuous path of light along both sides of the aisle leading to an exit from any row of seats within the cabin.

45. An emergency lighting system according to claim 44 wherein each track is arranged to extend below the armrest of the adjacent seat on that side of the aisle and preferably the inner edge of the

track adjacent to the aisle is located substantially perpendicular to the outer edge of the armrest.

46. An emergency lighting system according to any of claims 43 to 45 wherein the photoluminescent guide means is provided at or near ceiling level and is preferably a mirror image of the guide means at or near the floor and optionally of similar construction and/or may include similar symbols, words or markings to indicate the direction to the nearest exit.

47. An emergency lighting system according to any of claims 43 to 46 wherein each row of seats is provided by a demountable multi-seat unit on each side of the aisle allowing the number and arrangement of seats to be altered, for example seat units comprising two, three or four seats may be provided.

48. An emergency lighting system according to claim 47 wherein the seat units are provided with photoluminescent material on the outside of the aisle seat, preferably close to the floor.

ABSTRACT
EMERGENCY LIGHTING

An integrated photoluminescent lighting system for evacuation of an aircraft in an emergency. The system is operable independently of any electrical power source to guide passengers to an exit 13, identify the exit 13 both when closed and open and to assist opening of the exit 13. The system includes photoluminescent guide means 5 for identifying an escape route, photoluminescent indicator means 17 for identifying the exit 13, and photoluminescent sign means 18 for identifying the instructions and controls for opening the exit 13. The guide means 5 includes photoluminescent material arranged to emit a path of light along an aisle 4 towards the exit 13. The indicator means 17 includes photoluminescent material arranged to emit a band of light framing the exit 13. The sign means 18 includes photoluminescent material arranged to illuminate the operating instructions and to indicate the opening movement of a control handle 22 to open the exit 13.

Figures 1 and 4

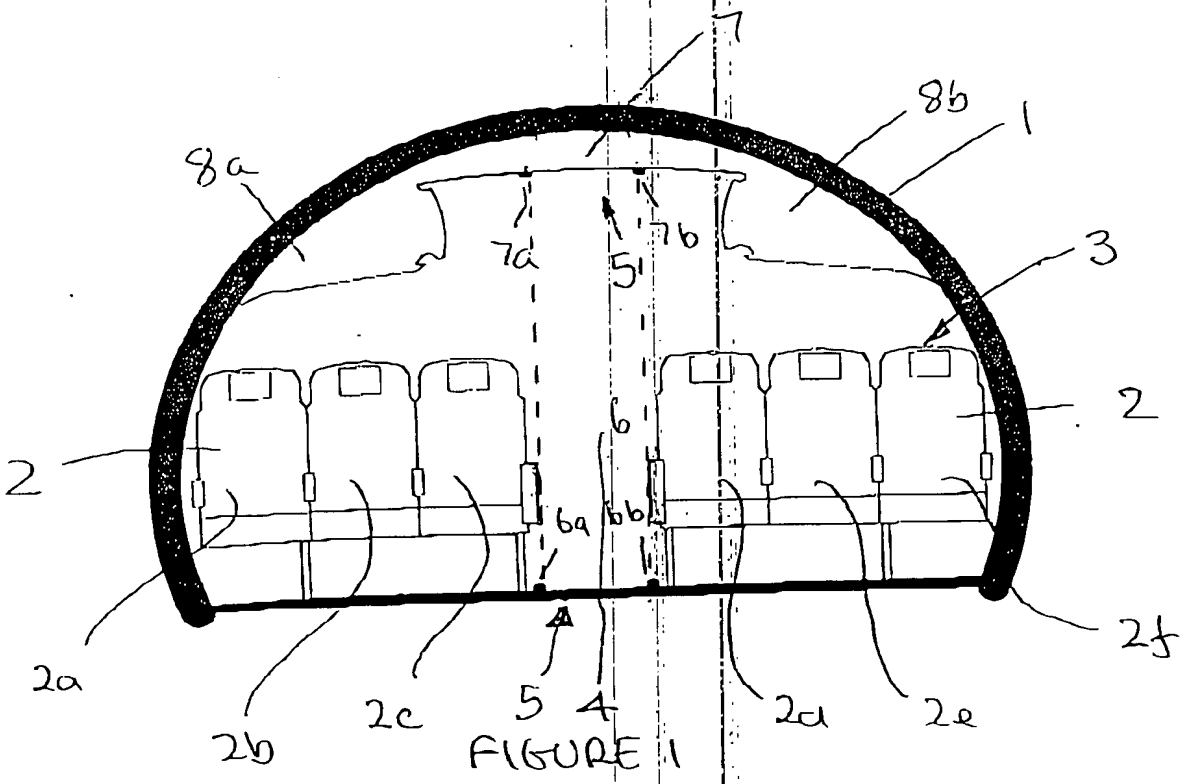

FIGURE 1

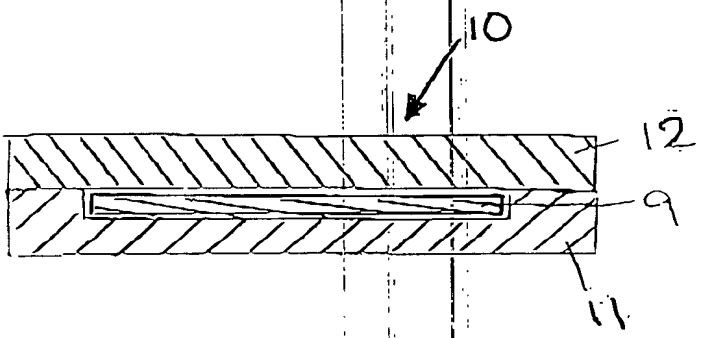

FIGURE 2

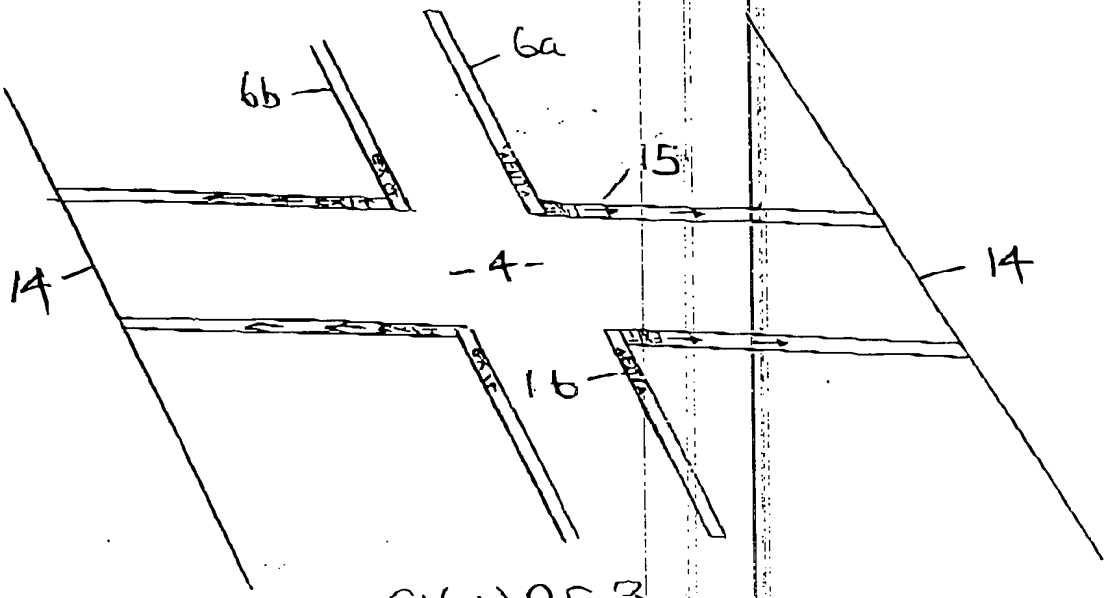

FIGURE 3

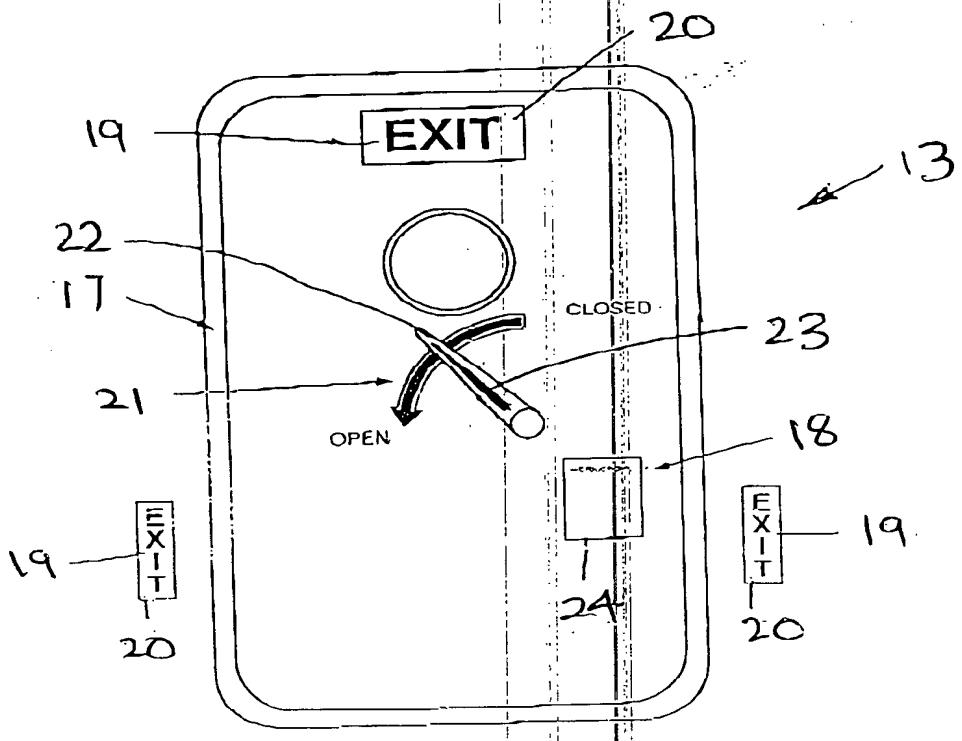

FIGURE 4

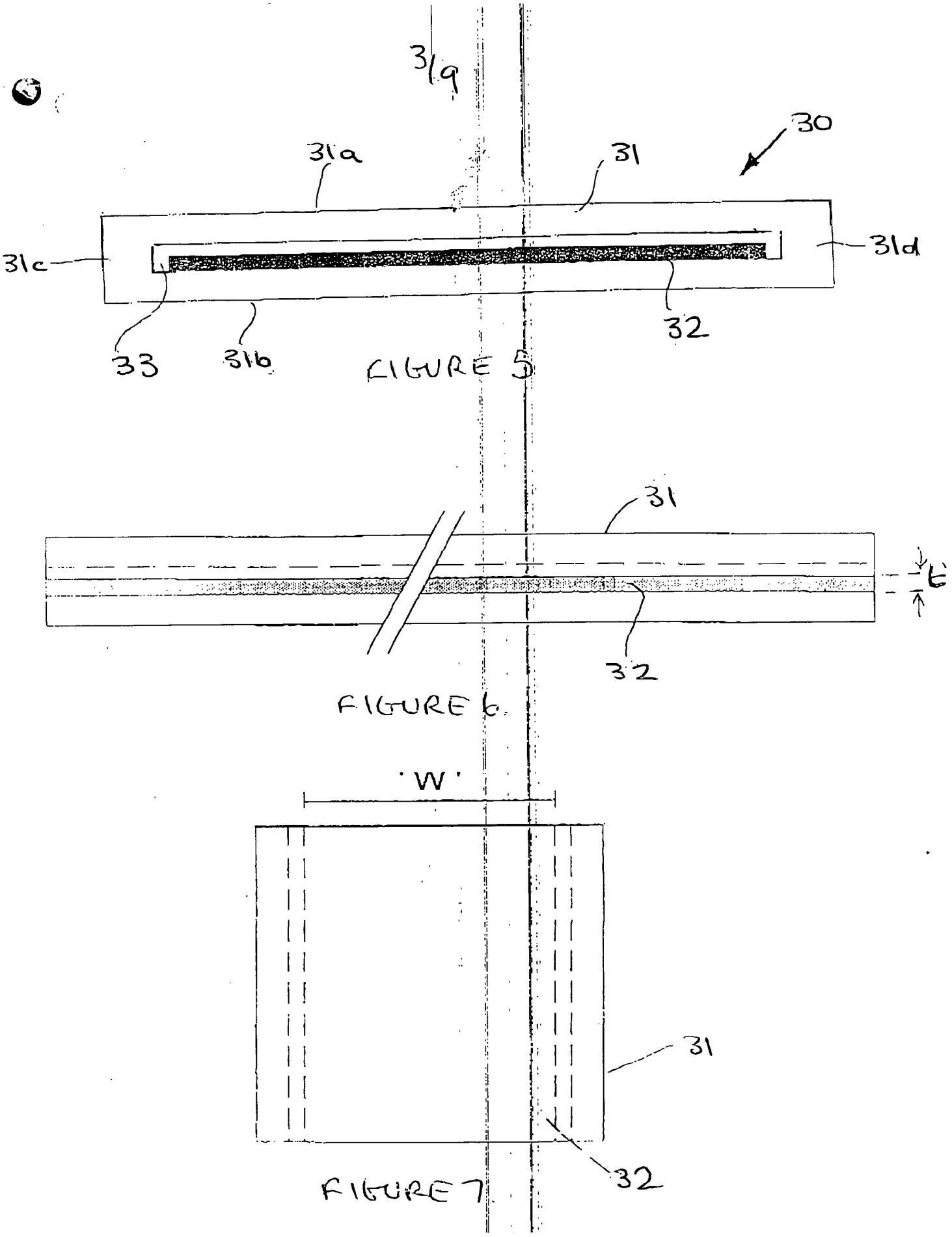

FIGURE 5

FIGURE 6.

FIGURE 7.

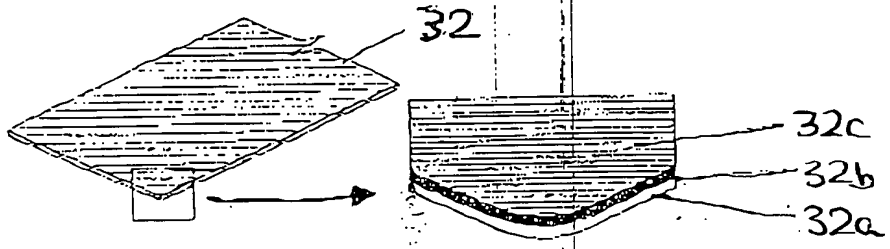

FIGURE 8

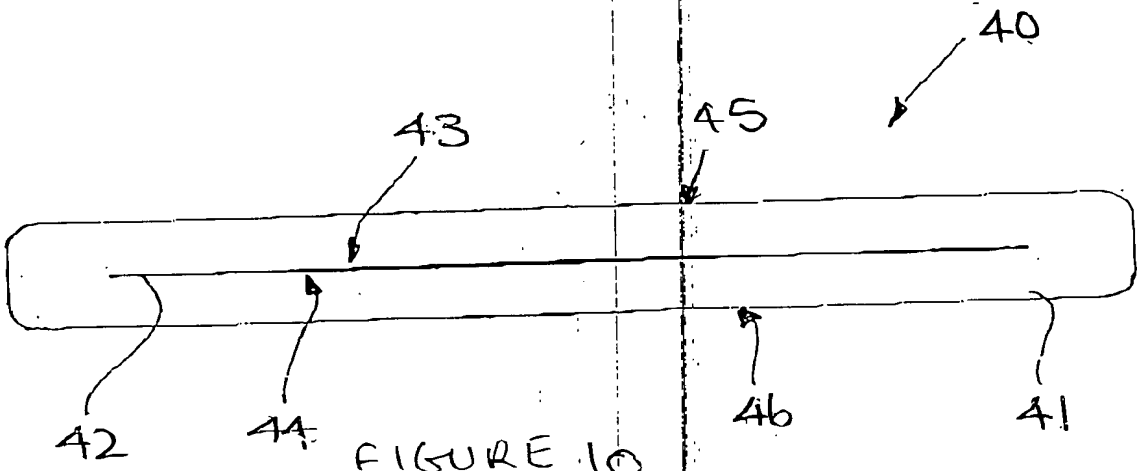

FIGURE 10

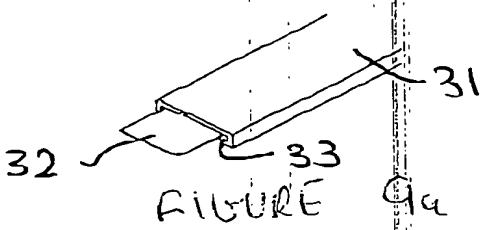

FIGURE 9a

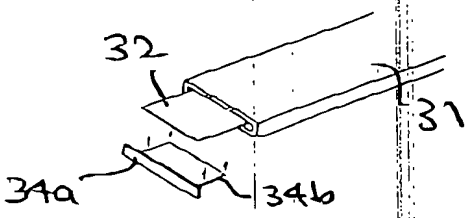

FIGURE 9b

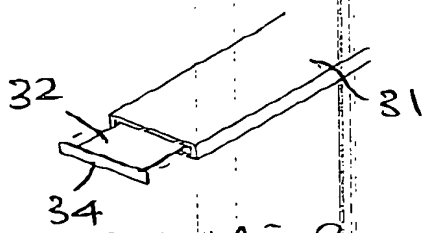

FIGURE 9c

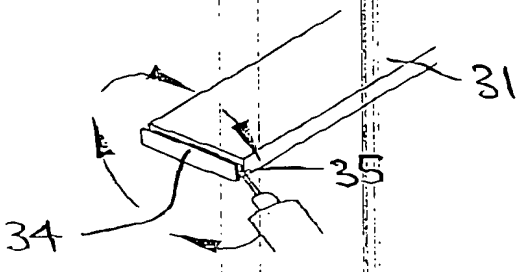

FIGURE 9d

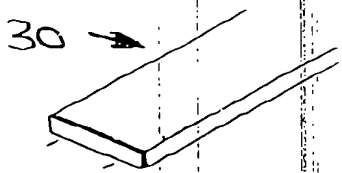

FIGURE 9e

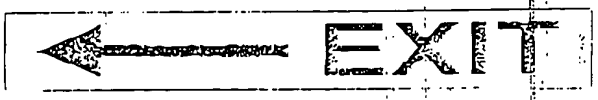

FIGURE 11a

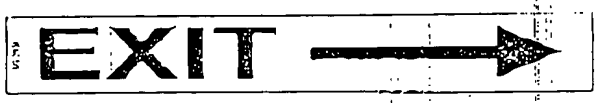

FIGURE 11

FIGURE 11

FIGURE 11f

FIGURE 11d

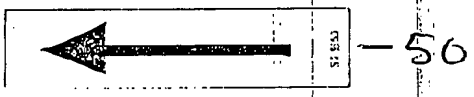

FIGURE 11e

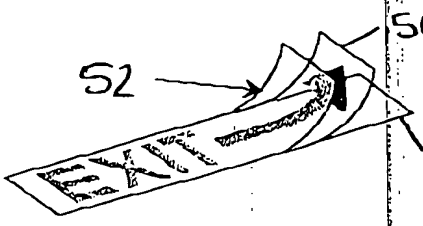

FIGURE 12a

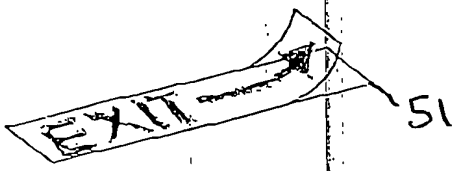

FIGURE 12b

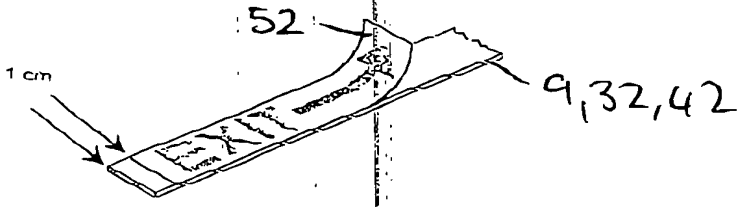

FIGURE 12c

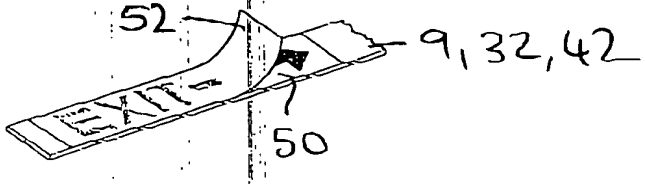

FIGURE 12d

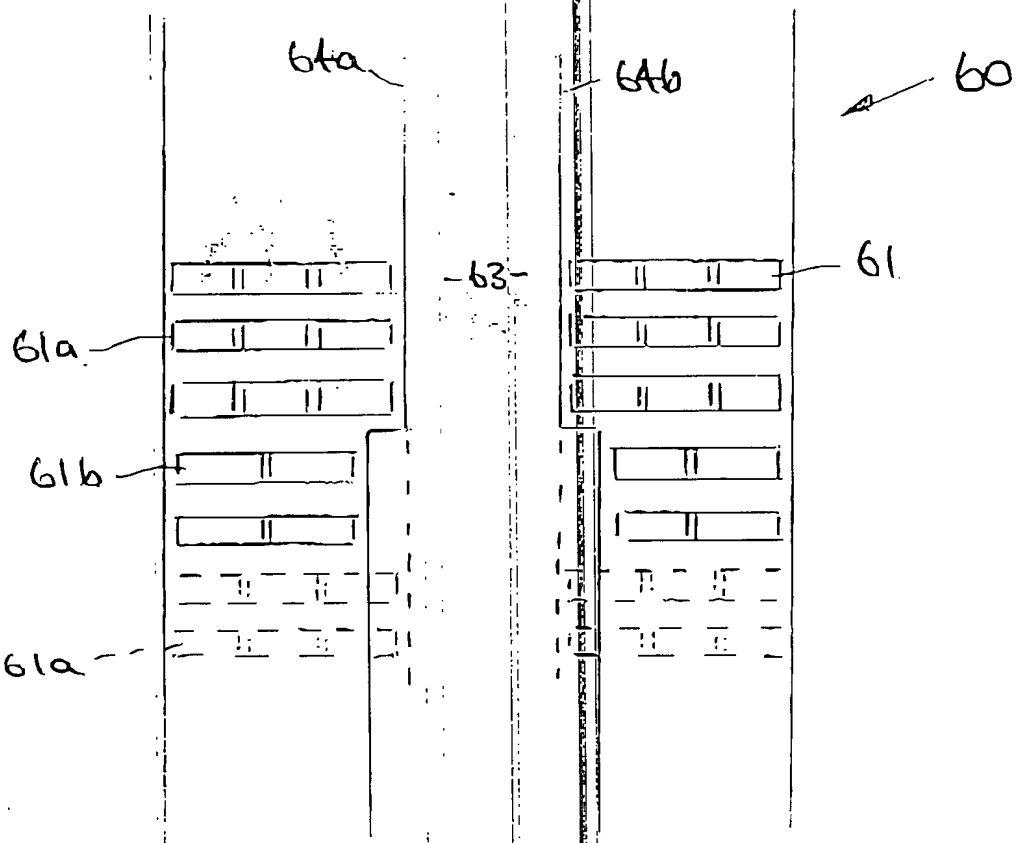

FIGURE 13

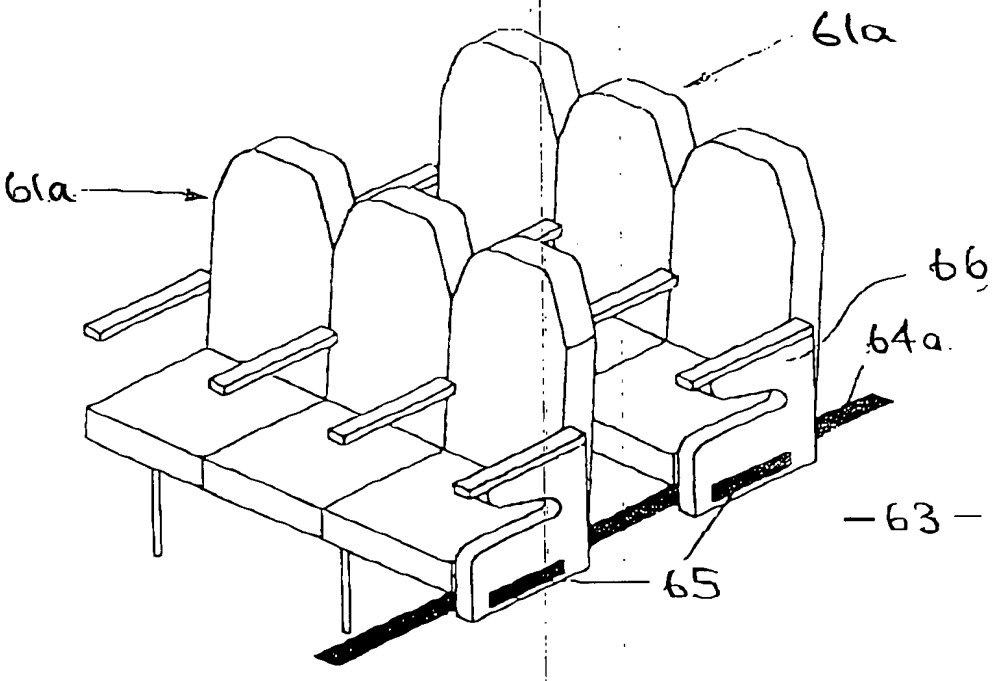

Figure 14